AfL Lesson Example 1 (Science)

Subject	Chemistry	**Level / Stream**	Sec 3 Express
Topic	Ionic Bonding	**Class size**	27
Lesson Duration	1 hour	**Date conducted**	26 March 2019
Prior knowledge	Students have learnt how to describe the formation of ions by electron loss/gain in order to obtain the electronic configuration of a noble gas.	**Student profile**	Students comprise mostly of kinaesthetic and visual learners. They need time to digest content delivered and have to be called upon to answer questions in class.

Intended Learning Outcomes

1. Draw the 'dot and cross' diagrams of ionic compounds
2. Describe the formation of ionic bonds between metals and non-metals, e.g. NaCl; $MgCl_2$

Lesson

AfL process	Timestamp	Activity	Tips/Remarks
 **Explaining**	[00:00]	Teacher recaps the main points of the previous lesson and links it to the learning objectives of the day.	
 **Exploring**	[00:29]	Teacher gets students to recall what they remembered about ions that they learnt in the previous lesson and write it on the online platform 'Nearpod' to gauge whether students are ready to move on to the next topic.	📖 Mini whiteboards or even blank pieces of paper can be used as substitutes to online platforms.
 **Engaging**	[00:54]	Teacher shows on the screen what students have written and gives her feedback.	✍ Instead of just saying, 'Good job', be specific about what students did right.

	**Exploring**	[01:02]	Still on recap of previous lesson. Teacher gets students to draw either an aluminium atom or aluminium ion. She shows their responses on the screen and gives feedback.	
	**Explaining**		She reminds the students to draw the bracket and the charge when drawing ions.	✍ This encourages students to self-assess their work.
	**Engaging**		She invites the students to evaluate their peers' work.	
	**Explaining**	[01:46]	Teacher reiterates the lesson objective by linking what they have recapped with the day's learning outcome.	
	**Explaining**	[01:56]	Teacher explains the transfer of electrons during the formation of ionic compounds using the use of button magnets. Teacher models how to draw the diagram for sodium chloride.	
	**Exploring**	[02:25]	Teacher asks questions to elicit students' understanding.	
	**Engaging**		When student provides a wrong answer, teacher prompts him to think again and justify his answer. Teacher then provides tips on how to remember what the charge of the ion is.	📖 Confusing between negative and positive charges is a common problem students face. An activity to reinforce their conceptual understanding might be helpful.
	**Explaining**	[03:02]	After explaining another example, the drawing of magnesium fluoride, teacher breaks down the marks that would be given for such a question.	
	**Exploring**	[03:21]	Students are given a question to try on their own. Teacher walks around to elicit evidence of learning and pick up misconceptions to address.	

	**Engaging**	[03:39]	Teacher shows a student's worksheet where a mistake was made. Teacher offers the student a chance to correct his mistake. Teacher engages the rest of the class to offer feedback on how to further improve the answer.	📖 Another form of peer assessment can also be conducted here. Get students to check their partners' work. This allows more students to have their work checked and encourages greater student ownership of learning.
	**Explaining**	[04:42]	Teacher shows another student's worksheet that she deems as a good example of what she expects from them.	
	**Exploring**	[05:11]	Based on her observations of the students' first practice, teacher feels students need to have more practice. Teacher gives another question for them to try on their own in class (draw diagram of beryllium fluoride).	📝 Pace the lesson based on students' progress instead of rushing to finish the syllabus. 📝 Provide opportunity for students to learn from their mistakes.
	**Engaging**	[05:33]	Teacher addresses a mistake she found the moment she encounters it.	📝 Addressing a mistake as soon as it is made help students remember better.
	**Engaging**	[05:53] [06:18]	Teacher engages students to assess their peers' work as she shows them on the screen, asking them to justify their comments. Teacher explains in detail the mistakes students make and how they can correct it.	
	**Explaining**	[06:50]	Teacher reminds students to take note of the mistakes their peers had made and to avoid them in their own work.	

Legend

📖 Alternative activities ⏳ Time saving tips 📝 General remarks

Planning stage

It was also noted that in previous years, students struggled with this topic because they could not grasp concepts at the particle level so the teacher made use of button magnets to help them visualise the transfer of electrons.

Comment by research team: Students may still have the misconception that an ionic compound exists in singular particles (similar to single molecular particles in covalent compounds e.g. MgF_2 as a single particle made of 1 Mg^{2+} ion and 2 F^- ions) when in fact it should be a huge ionic crystal lattice made up of numerous Mg^{2+} and F^- in a ratio 1:2.

Post-Lesson Reflections

Previously worksheets were given for students to do and self-mark as the teacher goes through the answers with the class. This meant that students' mistakes often go unnoticed and only surfaced when a test was given. For this lesson, the use of 'Nearpod' helped the teacher surface individual students' progress within the lesson period and allow students to learn from their peers' mistakes.

There were some surprising answers that the teacher could not have pre-empted so the Nearpod activity was helpful in highlighting these, allowing the teacher to address them on the spot. Students do not seem to struggle so much in the subsequent lessons on ionic bonding as many issues they faced have already been addressed earlier. The use of Nearpod was particularly useful for this lesson because it allowed the students to draw and have their drawings shown on the screen. It was also easy to use (the teacher just needed to give a pin number for the students to join the online lesson in Nearpod without requiring them to have an account to log in).

Comment by research team: Feedforward may be in the form of questions or thinking tasks, requiring students to use the learnt concepts and skills in this lesson to think about the link between structures of ionic / covalent compounds and the physical properties of the giant structures found in nature, e.g. sodium chloride crystal lattice and diamond.

Points to Ponder

Reflect on your daily AfL practices in class.

1) Do you ensure that you complete at least one cycle of the AfL process of 'Explaining', 'Exploring' and 'Engaging' for each topic/skill that you teach?
2) Do you elicit evidence of students' learning during the lesson itself or depend mainly on assignments/quizzes after the lesson?

3) What are some of the AfL practices here that you can adopt? What are some of the constraints that you may face? Can you think of alternative strategies that can help you overcome these constraints?

Acknowledgements

This project was funded by the National Institute of Education (NIE), Nanyang Technological University, Singapore (RS 3/18 LWS). Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of NIE.

We would like to thank Ms Jeevana Rani and Mayflower Secondary School for their contributions in the making of these resources.